

# NETWORKERS 2003

THE POWER TO TRANSFORM BUSINESS. **now.**



## Introduction to Network Management

Session NMS-1001

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# Agenda

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## Part I

- The Need for Network Management
- Network Management Defined
- Protocols and Technologies
- Functional Areas of Network Management

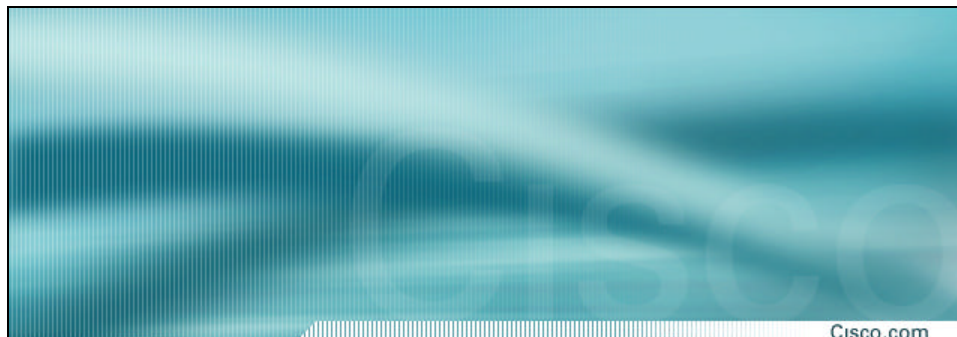
## Part II

- Preparing a Network for Management
- Real World Applications of Proper Management Practices

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## Part I

**Network Management Defined**  
**Protocols and Technologies**  
**Functional Areas of Network Management**

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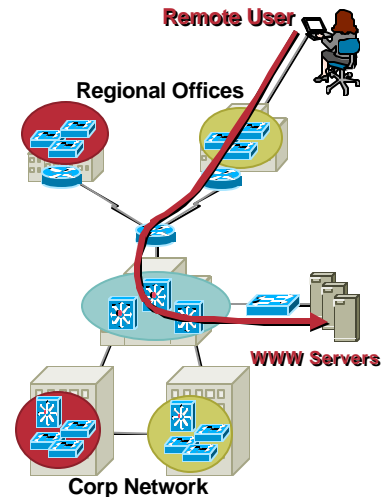
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# The Case for Management

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- **Typical problem**  
Regional user arrives at work and experiences slow or no response from corporate web server
- **Where do you begin?**  
Where is the problem?  
What is the problem?  
What is the solution?
- **Without proper network management, these questions are difficult to answer**



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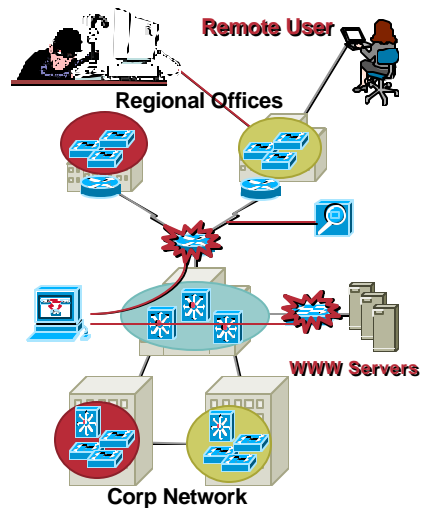
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# The Case for Management

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- **With proper management tools and procedures in place, you may already have the answer**
- **Consider some possibilities**
  1. What configuration changes were made overnight?
  2. Have you received a device fault notification indicating the issue?
  3. Have you detected a security breach?
  4. Has your performance baseline predicted this behavior on an increasingly congested network link?



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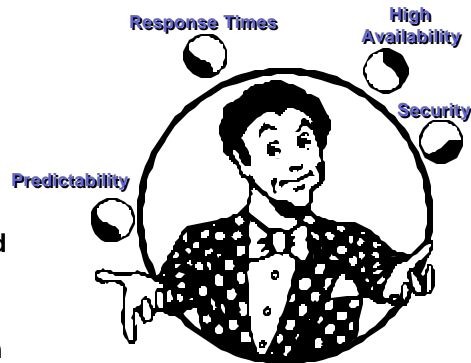
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## The Case for Management

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### Solving a Typical Problem Like This Includes the Following:

- An accurate database of your network's **topology**, **configuration**, and **performance**
- A solid understanding of the **protocols** and **models** used in communication between your management server and the managed devices
- **Methods** and **tools** that allow you to interpret and act upon gathered information



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## ROI Example Using a Management Tool for Daily Tasks

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Number of Managed Devices	800
Average Manual Process Time Required (Man-Hours)	
Software Upgrade	0.05 (3 Min/Device/Qtr)
Password Change	0.25 (19 Min/Device/Bi-Annual)
Gather Inventory Information	0.03 (2 Min/Device/Qtr)
Documenting Changes	0.08 (5 Min/Incident)
Audit	30.00 (Per Qtr)
Cost per Man-Hour	\$48.84
Manual Configuration Error Rate	2%

Configuration Management Process	Manual Procedure Required Man-Hours (per Annum)	After Product Implementation	Time Savings	ROI
Password Change	435	44	391	\$19,106.21
Software Upgrade	544	0.37	544	\$26,551.05
Gather Inventory Information	381	0.67	380	\$18,565.71
Documenting Changes	120	0.67	119	\$5,828.24
<b>Total Configuration Management ROI</b>				<b>\$70,051.21</b>

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Source: Cost Analysis Using CiscoWorks LAN Management Solution. Esaka, 2002

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# The Network Manager's Responsibility

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- Ensure that the users of a network **receive the information technology** services with the quality of service that they expect
- Strategic and tactical planning of the **engineering, operations, and maintenance** of a network and network services
- Help network engineers deal with the complexity of a data network and to make sure that data can go across it with **maximum efficiency and transparency** to the users



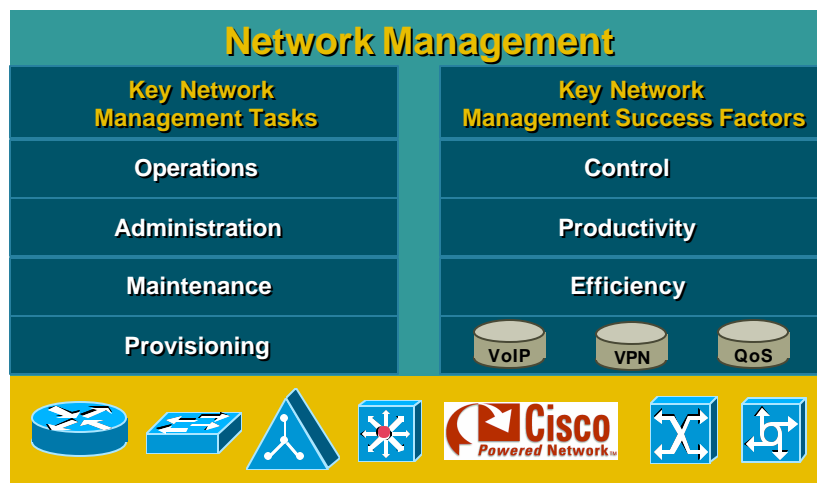
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# Network Management Defined

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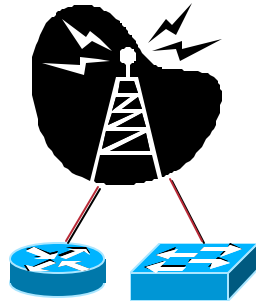
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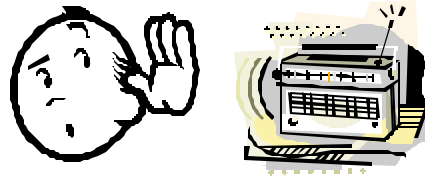
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# Communicating with the Network

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Managed Network Elements Are **Waiting** to Provide Us with Useful Information...



Network Management Begins with an Understanding of How to Collect and Interpret This Information

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# Methods of Communication

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	Example	Security Options
<b>Console</b>	Terminal Server	Device Usernames TACACS/RADIUS
<b>Telnet</b>	ReflectionX Software	SSH
<b>HTTP</b>	Embedded Device Management	SSL (HTTPS)
<b>SNMP</b>	MRTG Multi Router Traffic Grapher	SNMPv1, 2c – Access Lists SNMPv3 – Auth/Priv

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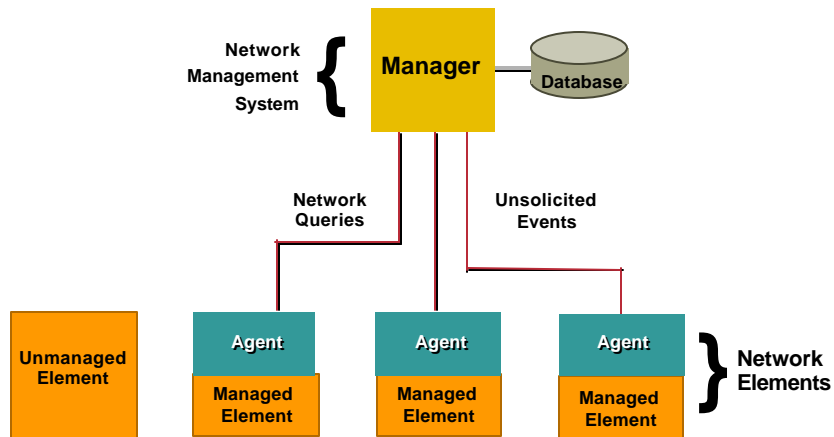
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# Two-Tier Management Communication

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## The Model



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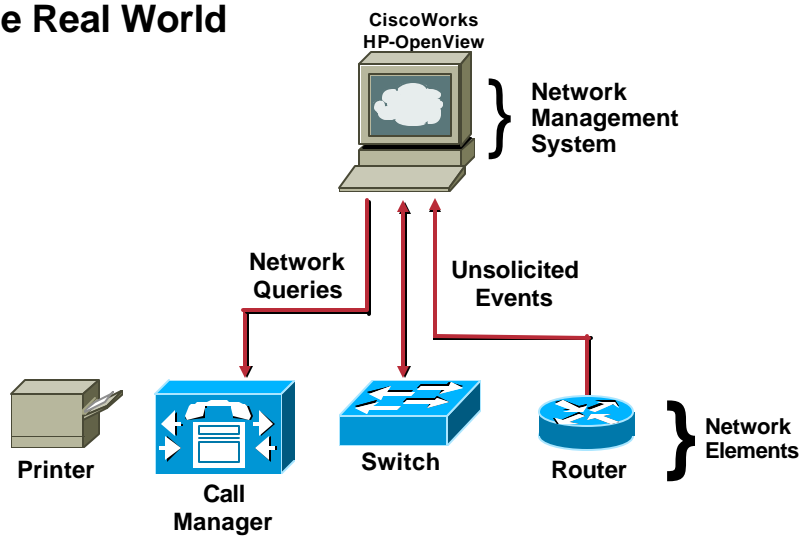
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# Two-Tier Management Communication

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## The Real World



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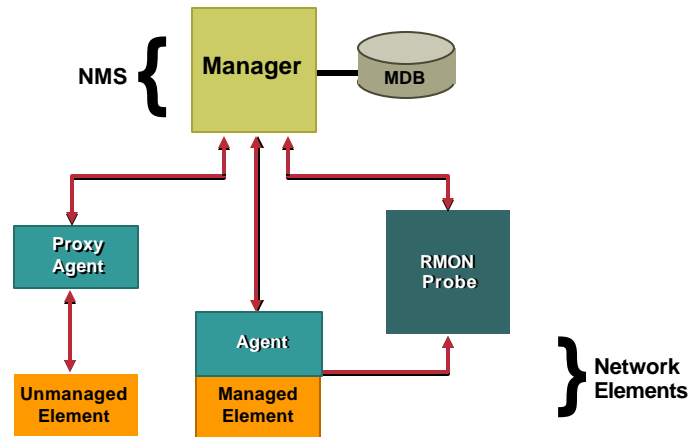
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# Three-Tier Management Communication

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## The Model



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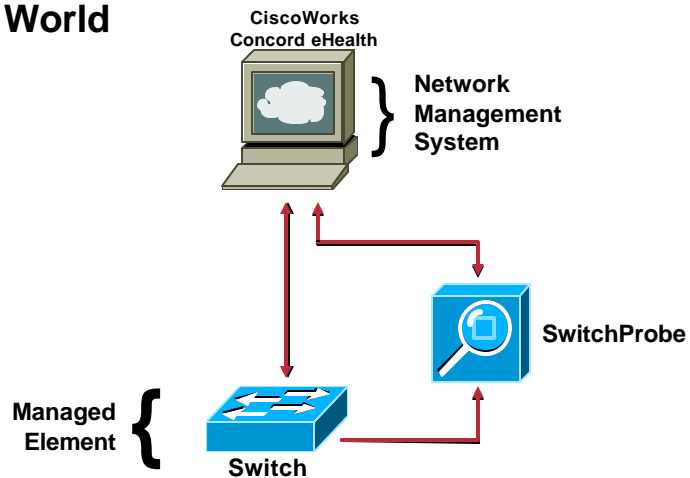
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# Three-Tier Management Communication

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## The Real World



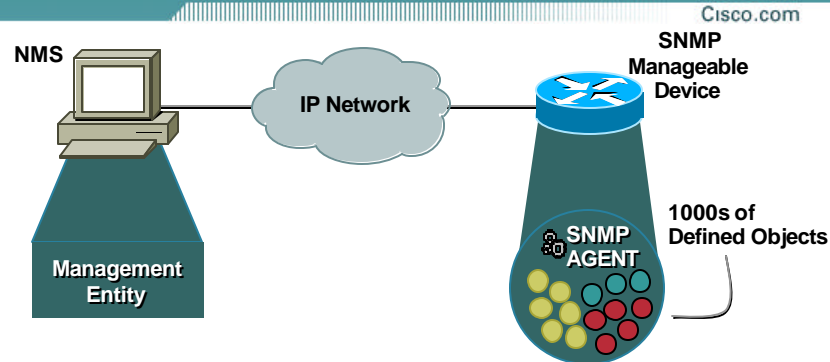
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## SNMP Primer: Understanding the Agent



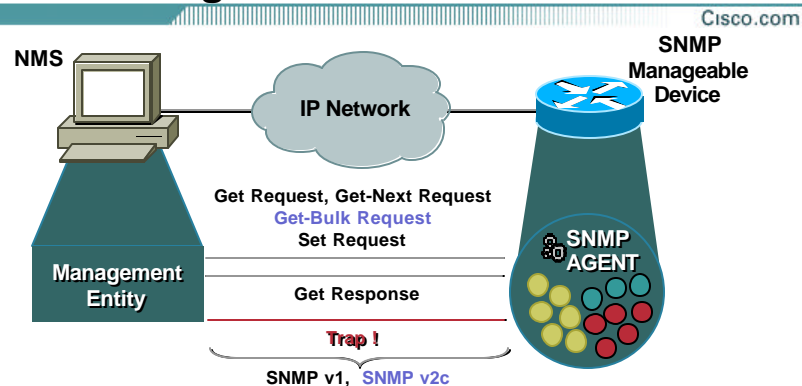
- Information storehouse
- Information structured as per Structure of Management Information (SMI) standards
- Object definitions provided in many Management Information Bases (MIBs)

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## SNMP Primer: Understanding the Protocol



- Get requests used to read the value of object
- Set requests used to modify the value of object
- Traps provide asynchronous event notification

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# Configuring NM Protocols

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## SNMP

	Level	Auth	Encryption	What Happens
SNMPv1	noAuthNoPriv	Community String		Uses a community string match for authentication
SNMPv2c	noAuthNoPriv	Community String		Uses a community string match for authentication
SNMPv3	noAuthNoPriv	Username		Uses a username match for authentication
SNMPv3	authNoPriv	MD5 or SHA		Provides authentication based on HMAC-MD5 or HMAC-SHA algorithms
SNMPv3	authPriv	MD5 or SHA	DES	Adds DES 56-bit encryption in addition to authentication based on DES-56

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# Measurement Technology SNMP Protocol - Background

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- Simple Network Management Protocol
- IOS versions
  - 10.3 -> SNMPv1 + v2
  - 11.0, 11.1, 11.2 -> SNMPv1 + v2
  - 11.3 -> SNMPv1 + v2c
  - 12.0 -> SNMPv1 + v2c
  - 12.0(3)T -> SNMPv1 + v2c + v3
  - 12.0(6)S -> SNMPv1 + v2c + v3
  - 12.1 -> SNMPv1 + v2c + v3
  - 12.2 -> SNMPv1 + v2c + v3

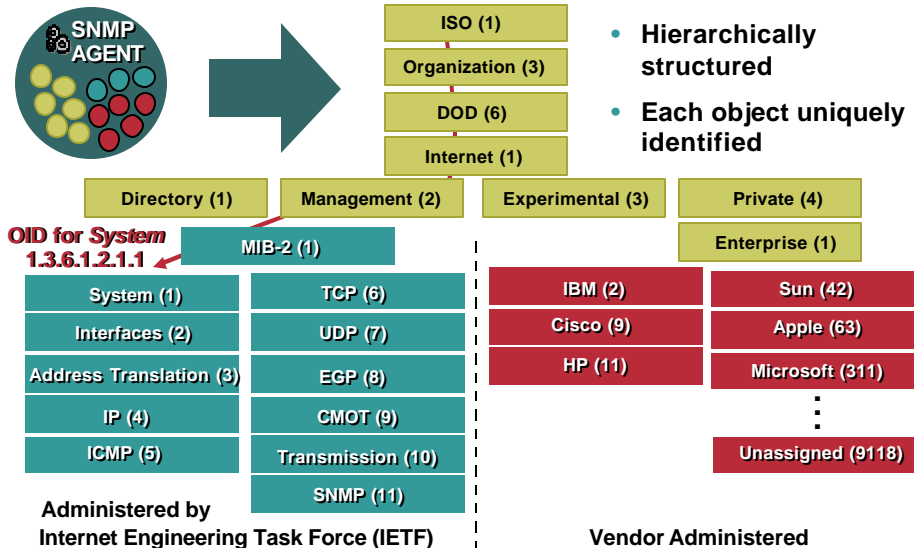
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# MIBs Object Identifiers

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## SNMP Object Identification

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- Need a scheme that allows two vendors or products within a vendor to compare like items

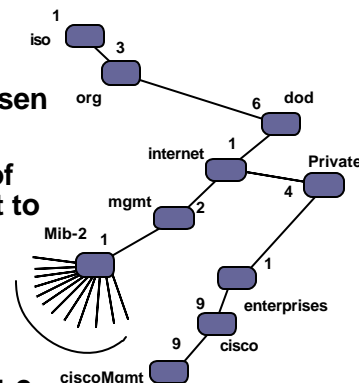
Object Identifiers (OID) were chosen as the identification scheme

An OID is an ordered sequence of non-negative integers written left to right, containing at least two elements (0.0)

Bound to simple names in MIB Modules:

“ifDescr” is 1.3.6.1.2.1.2.2.1.2

“ifInOctets” is 1.3.6.1.2.1.2.2.1.10



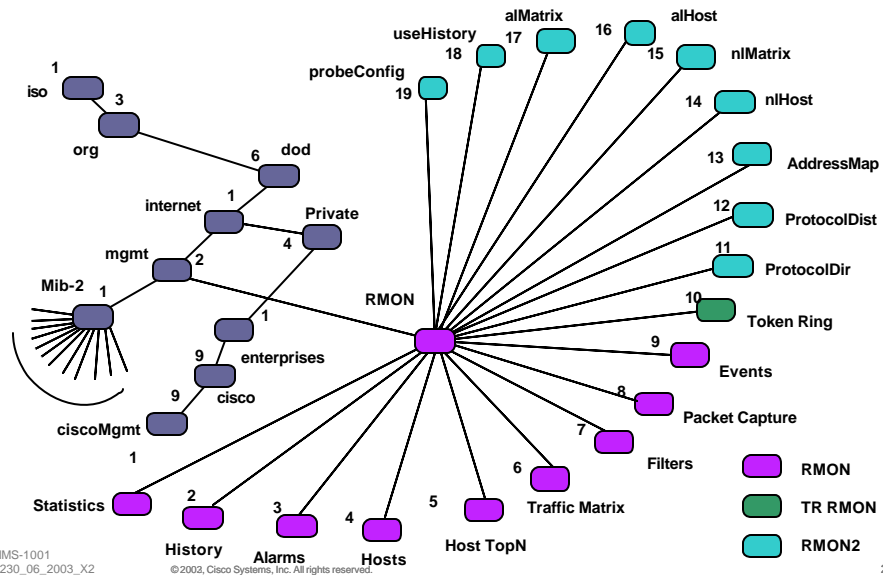
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## SNMP Object Identifiers

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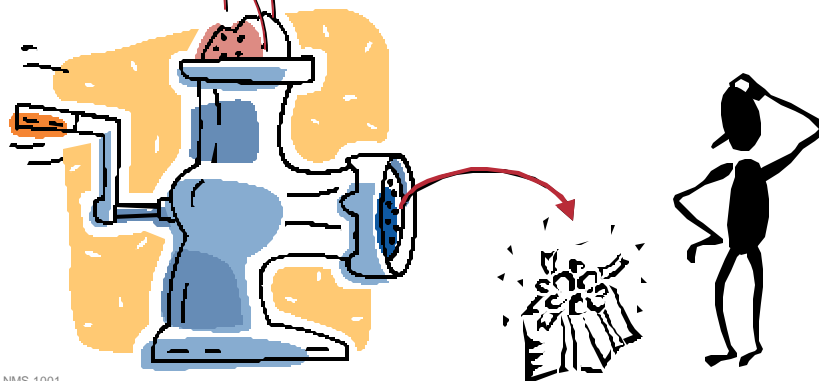
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## Applying a Management Model

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**SNMP Reads  
MIB Values  
Packet Capture**

Now That You Have Gathered  
Network Information, What  
Should You Do with It?



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## The Five Facets of Proper Network Management

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- Addresses the network management **applications** that reside upon the NMS
- OSI model categorizes **five areas** of function (sometimes referred to as the FCAPS model):

**Fault**  
**Configuration**  
**Accounting**  
**Performance**  
**Security**



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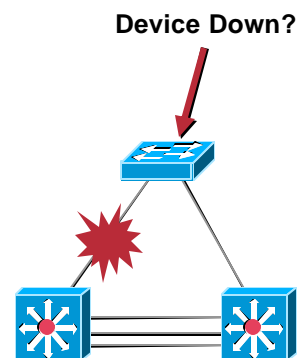
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## Fault Management

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- “The process of locating, diagnosing, and correcting network problems”
- Increases network reliability and effectiveness
- More than just “firefighting”
- Increases the productivity of network users



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## Fault Management

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- **Steps for successful fault management:**
  - ✓ Identify the problem by gathering information about the state of the network (polling and trap generation)
  - ✓ Restore any services that have been lost
  - ✓ Isolate the cause and decide if the fault should be managed
  - ✓ Correct the fault if possible

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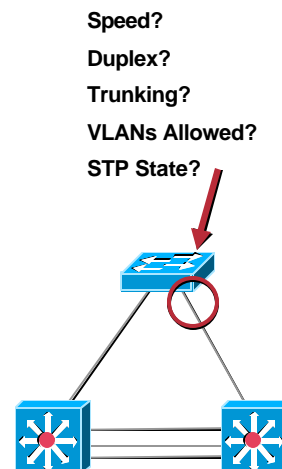
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## Configuration Management

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- “The process of obtaining data from the network and using that data to manage the setup of all network devices”
- Allows rapid access to configuration information
- Facilitates remote configuration and provisioning
- Provides an up-to-date inventory of network components



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## Configuration Management

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- **Steps for successful configuration management:**
  - ✓ **Gather current network configuration (either manually or automatically)**
  - ✓ **Use that data to modify network device configuration in order to provision the network**
  - ✓ **Store the configuration data and maintain an up-to-date inventory of all network components**
  - ✓ **Produce various inventory reports**

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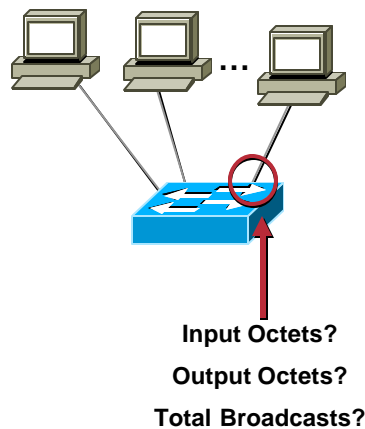
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## Accounting Management

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- **“Measuring the usage of network resources by users in order to establish the metrics, check quotas, determine costs, and bill users”**
- **Measures and reports accounting information based on individual groups and users**
- **Administers the cost of the network**
- **Internal verification of third-party billing for usage**



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## Accounting Management

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- **Address the different steps involved for accounting management:**
  - ✓ **Gather network resource utilization information**
  - ✓ **Use metrics to set usage quotas**
  - ✓ **Billing users for their network use**
  - ✓ **Consider the cost of accounting**

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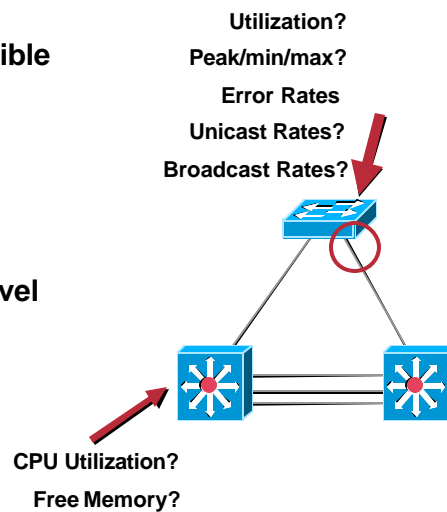
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## Performance Management

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- **“Ensuring that the data network remains accessible and as uncongested as possible”**
- **Reduces network overcrowding and inaccessibility**
- **Provides a consistent level of service to the network user**
- **Determine utilization trends to proactively isolate and solve performance problems**



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## Performance Management

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- **Steps for successful performance management**
  - ✓ **Collect data on current network link and device utilization**
  - ✓ **Baseline the utilization metrics and isolate any existing performance problems**
  - ✓ **Set utilization thresholds based on the baseline**
  - ✓ **Analyze the historical data for recognizing trends**
  - ✓ **Resource planning and tuning**
  - ✓ **Remember – Measuring performance impacts performance**

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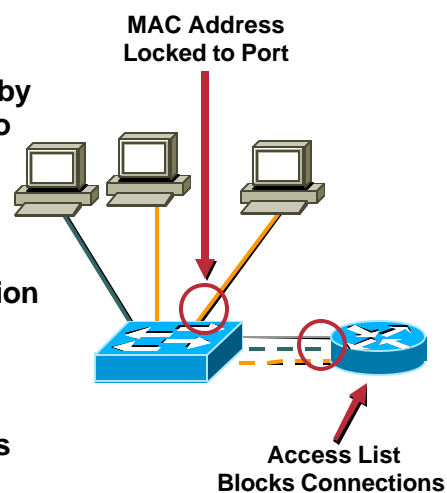
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## Security Management

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- **“Protecting sensitive information on devices attached to a data network by controlling access points to that information”**
- **Builds network user confidence**
- **Secures sensitive information from both internal and external sources**
- **Protects the network functionality from malicious attacks**



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## Security Management

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- **Steps for successful security management:**

- ☒ Identify sensitive information or devices
- ☒ Find the access points
- ☒ Secure the access points
- ☒ Protect the sensitive information by configuring encryption policies
- ☒ Implement a network intrusion detection scheme to enhance perimeter security

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## Part II

**Preparing the Network for Management**

**Real World Applications of Proper Management Practices**

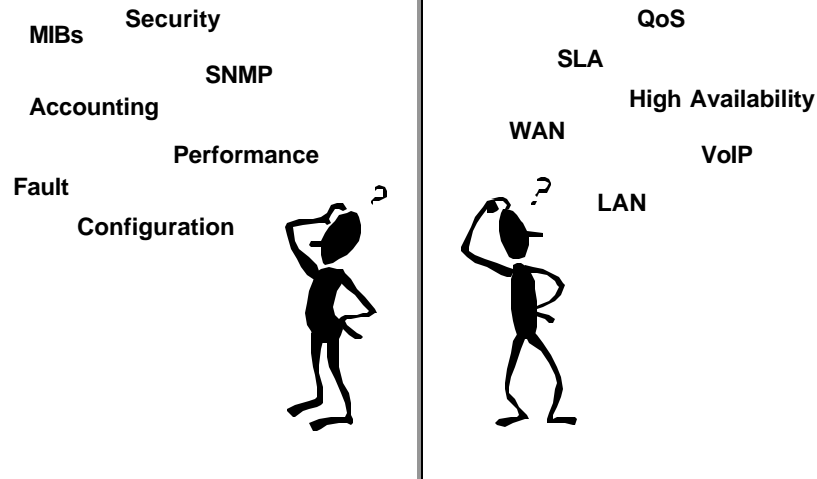
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# Preparing Devices for Management

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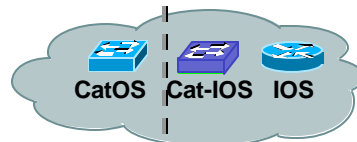
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# Configuring SNMP

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```
set snmp community read-only <text>
set snmp community read-write <text>
set snmp community read-write-all <text>
set snmp trap <IP_Addr> <comm_string>
set snmp trap enable all
set snmp rmon enable
```

```
snmp-server community <text> RO
snmp-server community <text> RW
snmp-server enable traps
snmp-server host <IP_Addr> traps <comm_string>
snmp-server trap-source loopback0
```

- Configuration syntax operating system (OS) dependant
- CatOS' agent has two write access policies
  - Read-write—partial configuration access
  - Read-write-all—full configuration access
- CatOS's agent has defaults—**Change them!**
  - R/O = public • R/W = private • R/W/A = secret

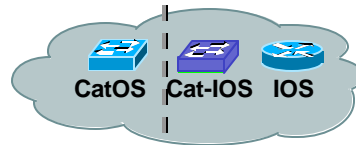
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## Configuring Syslog

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```
set logging server <IP_Addr>
set logging server level 6
set logging server facility local7
set logging level sys 6 default
set logging timestamp
set logging enable
```

```
logging on
logging <hostname | IP_Addr>
logging facility local7
logging trap informational
logging source-interface loopback0
service timestamps log datetime
```

- Syntax differs between IOS and catalyst OS devices
- Message textual format differs between IOS and catalyst OS devices
- Resource manager essentials requirement  
Logging level informational (6)

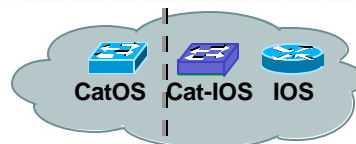
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## Configuring Telnet

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```
set password <passwd>
set enablepass <passwd>
```

```
enable password <passwd>
line tty 0 4
password <passwd>
login [local/tacas]
```

- Syntax differs between IOS and catalyst OS devices
- Catalyst switches have telnet enabled but no console/telnet or enable passwords by default—add them
- IOS devices do not have telnet enabled  
Enable for management support  
Secure with TACAS+

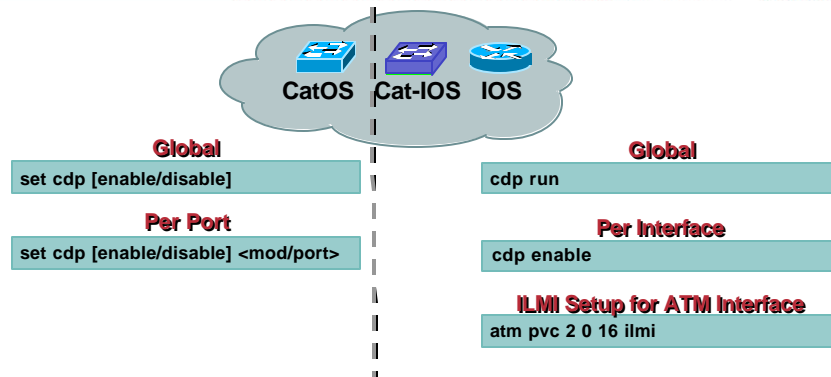
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## Configuring CDP and ILMI

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- Syntax differs between IOS and catalyst OS devices
- CDP enabled by default on most interfaces

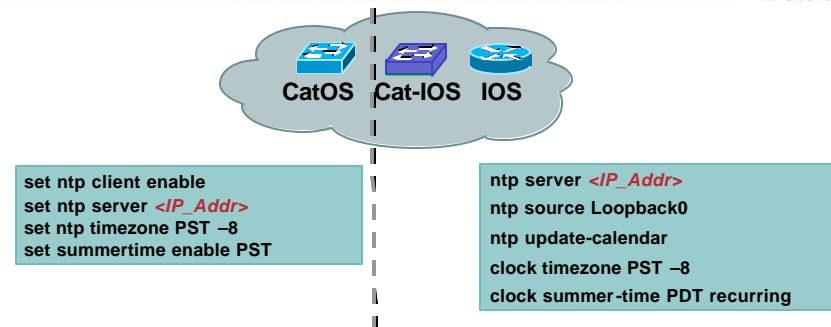
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## Configuring NTP

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- Syntax differs between IOS and catalyst OS devices
- Configure NTP on management server
- Time synchronization important for proper syslog, traps, and monitoring correlation

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## Additional Configuration

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- **Cisco IOS device**

**Hostname and SNMP  
contact, location,  
chassis-id**

**User login authorization  
local or TACACS+**

**SNMP access lists**

**RMON alarms and  
events (statistics and  
history if available)**

- **Catalyst switch**

**System name,  
contact, location**

**User login authorization  
local or TACACS**

**Mini-RMON statistics,  
history, alarms,  
and events**

**VTP domain name**

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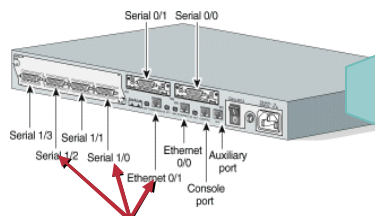
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## Designing for Management Preferred Management Interfaces

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- Management systems communicate via IP with managed devices
- The IP address should be chosen carefully to provide the highest availability
- It is a best practice to use a very stable physical address or a configured Loopback address



```
interface Loopback0
ip address 192.168.79.130 255.255.255.255

interface Vlan60
ip address 192.168.79.62 255.255.255.252
```

**Physical Interfaces—Actual  
ports on router chassis**

- Ethernet0/0
- Serial 0/1

**Virtual Interfaces—Only exist  
in the device configuration**

- LoopBack0
- VLAN interfaces

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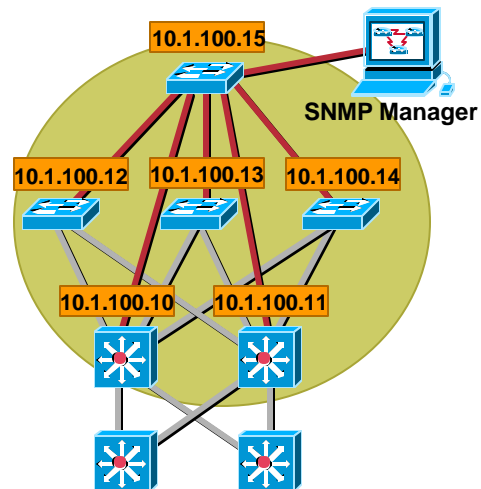
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## Designing for Management Redundant Infrastructure

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- High availability management
- Completely separates management from user data
- Management link is in separate subnet, VLAN, and switch
- Higher assurance for management data delivery during congestion or convergence



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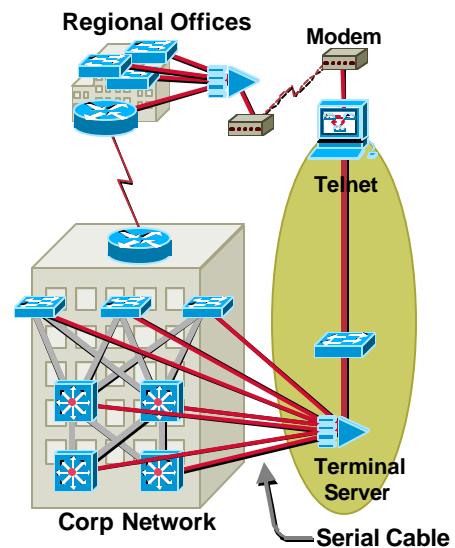
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## Designing for Management Terminal Servers

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- Out of band
- Failsafe access
- Console connection only, no SNMP
- Connect to redundant infrastructure
- Secure AUX ports when using modem



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## Incorporating FCAPS into the Network

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**Fault**  
**Configuration**  
**Accounting**  
**Performance**  
**Security**



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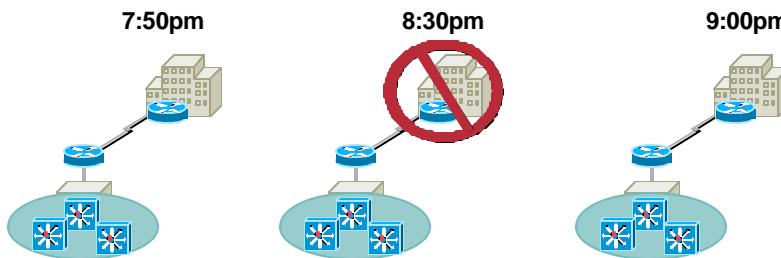
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## Fault Management Real World Example

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### The Problem

- Network administrator was receiving fault notifications of a recurring problem; each evening between 8:00 and 8:30 connectivity is lost to a branch office; connectivity is restored at approximately 9:00pm



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## Fault Management Real World Example

Cisco.com

### Considerations

- Is an entire **device** failing? If so, what device?
- Is a **link** failing? If so, which link?
- **How** can this be prevented in the future?

### Management Processes in Place

- Actively **polling critical devices** for availability
- **Notification tool** to alert administrator

**The Solution** →

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## Fault Management Real World Example

Cisco.com

### The Solution

The Loss of Connectivity  
Was Linked to the Late Night  
Janitor **Unplugging the WAN  
Router to Plug in His Radio**

The **Solution** Was to Provide  
the Late Night Janitor with an  
Extension Cord



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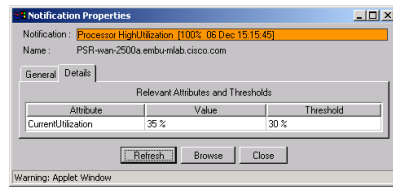
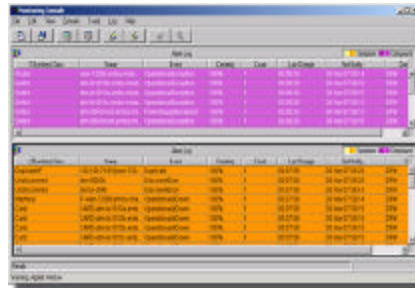
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## Fault Management Device Fault Manager

Cisco.com

- Administrator was notified of failure via a notification tool
- Device level fault analysis for Cisco products
- Identify POSSIBLE problems
- Determines root cause of exceptions
- Monitor for high availability
- Pager/e-mail/trap forwarding
- MIBs, polling intervals and thresholds set—OUT OF THE BOX
- **NO RULES TO WRITE**



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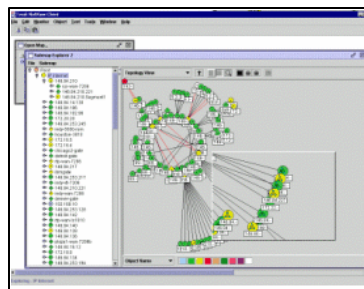
51

## Fault Management Tools HP and Tivoli

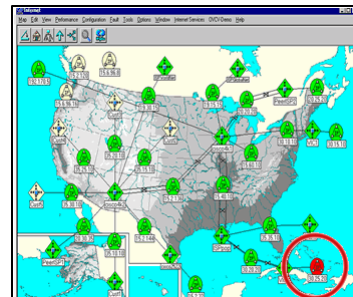
Cisco.com

- Correlate and manage events and SNMP traps

**Tivoli**



**hp** HEWLETT  
PACKARD



- Perform fault isolation and root cause analysis

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## Configuration Management Real World Example

Cisco.com

### The Problem

- Network administrator notices **night time configuration changes** in the production network followed by immediate configuration rollbacks to disguise any tampering

10:55pm

```
logging 192.168.76.228
logging 192.168.76.229
!
snmp-server community public R0
snmp-server community forks RW
snmp-server system shutdown
```

11:05pm

```
logging 192.168.76.228
logging 192.168.76.229
logging 192.168.76.4
!
snmp-server community public R0
snmp-server community spoons RW
snmp-server system shutdown
```

11:23pm

```
logging 192.168.76.228
logging 192.168.76.229
!
snmp-server community public R0
snmp-server community forks RW
snmp-server system shutdown
```

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## Configuration Management Real World Example

Cisco.com

### Considerations

- **What** changes were made?
- **When** were the changes made?
- **Who** made them?
- **How** can this be prevented in the future?

### Management Processes in Place

- Devices configured to send config change **syslog messages** to NMS
- **User authentication** tool
- Configuration **archiving**

The solution →

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# Configuration Management Real World Example

Cisco.com

## The Solution

The Network Configuration Changes Were Being Made by a Colleague Studying for His CCIE Exam after Hours **Using the Production Network**

The **Solution** Was to Provide the Culprit with an Unused 2600 Router to Be Used in His Home



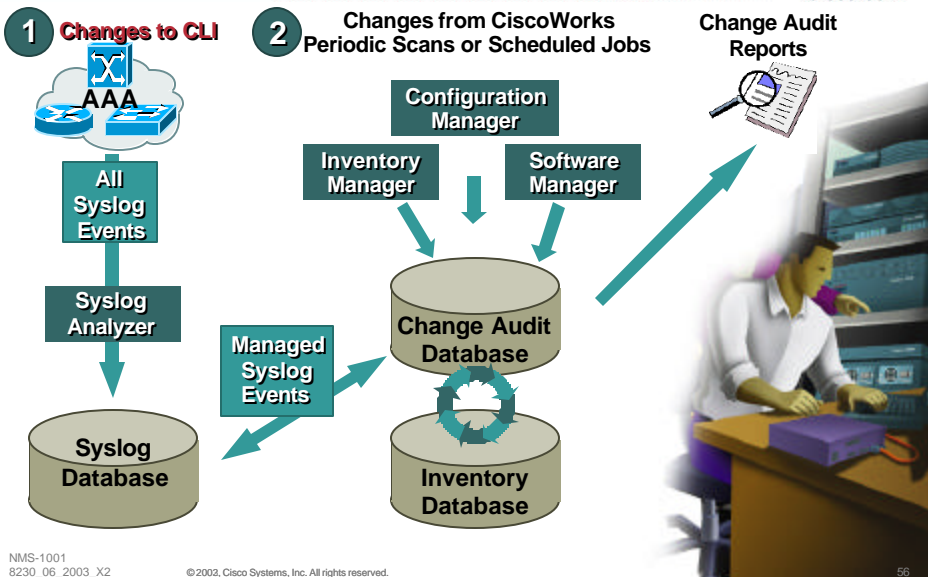
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# Configuration Management Resource Manager Essentials Change Audit Service

Cisco.com



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# Configuration Management RME Change Audit Setup

Cisco.com

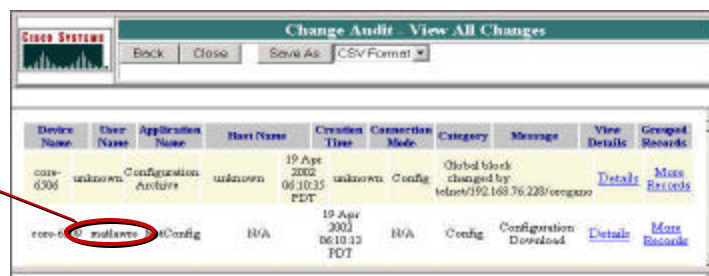
Change Audit relies on syslog messages to operate

- Point syslogs from all managed devices (except Pix firewalls) to the RME server

Collection of usernames occurs in 3 ways:

1. Using usernames on devices themselves
2. Using a RADIUS or TACACS server
3. Using a configurations change tool in RME (NetConfig, Config Editor)

That User Name  
Field Is  
Important to  
Most Customers



Device Name	User Name	Application Name	Host Name	Creation Time	Connection Mode	Category	Message	View Details	Grouped Records
core-6306	unknown	Configuration Archive	unknown	19 Apr 2002 06:10:35 PDT	unknown	Config	Global block changed by telnet/192.168.76.228/cengazoo	<a href="#">Details</a>	<a href="#">More Records</a>
core-6306	unknown	Config	R/A	19 Apr 2002 06:12:12 PDT	R/A	Config	Configuration Download	<a href="#">Details</a>	<a href="#">More Records</a>

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# Configuration Management Resource Manager Essentials

Cisco.com

- **Inventory Manager**  
Complete Cisco asset management  
Support for IGX, BPX and MGX
- **Software Image Manager**  
Software lifecycle management for routers and Catalyst switches  
Improved browse bug by device
- **Configuration Manager**  
Version control, archival, editing and reporting  
Network-wide config changes
- **Change Audit Services**  
Single interface for all hardware, software, and configuration changes

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# Configuration Management RME Inventory Manager

Cisco.com

- Hardware and software summary information
  - Chassis type
  - Memory
  - Flash
  - Modules
- Support for all Cisco devices in the network including Call Manager, VPN 3000, IGX, BPX, MGX
- Multiservice port reporting

**Detailed Device Report**

Device List

Device Information

Module	Slot	Model	Power Supply	Backplane	Chassis	Align	Type	Network	Mask
4	0	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300	WS-C6506-1300

**MultiService Port Details**

Device Name	Domain Name	Total Slots	Available Slots	Location	Power Supply 1	Power Supply 2	MultiService Modules	Module Port Count	Powered Port Count	User Field 1	User Field 2	User Field 3	User Field 4
demo-6506	demo-msh.cisco.com	6	3	EMBU Lab	1300	1300	1	48	48				
demo-6506	demo-msh.cisco.com	3	1	300	300	300	0	0	0				
demo-6506	demo-msh.cisco.com	9	3	EMBU Lab	1300	1300	1	48	48				

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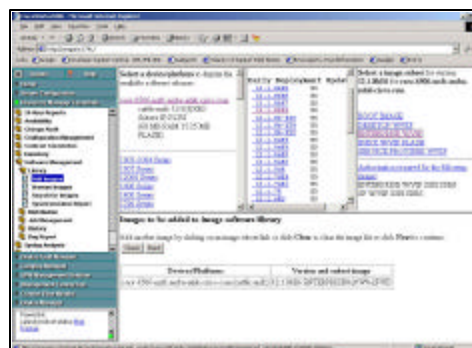
59

# Configuration Management IOS and CatOS Upgrades

Cisco.com

- Use a **dedicated** TFTP server to store and distribute software images
- or
- Resource Manager Essentials includes **Software Image Manager** to automate the upgrade process

```
core-6506-msfc#copy tftp flash
Address or name of remote host []? 19.16.76.175
Source filename []? 12.1.8a
Destination filename []? 12.1.8a
```



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# Configuration Management RME Configuration Manager

Cisco.com

- **NetConfig**

Wizard-based template for global configuration changes  
Changes can be performed against multiple devices in the network

Adhoc can be used for any CLIs



- **Config Editor**

Opens config from selected device in "notepad" like window

Edit functions (cut, paste)  
Changes a single device at a time



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# Configuration Management Access Control List Manager

Cisco.com

- **Integrated with CiscoWorks Resource Manager Essentials**

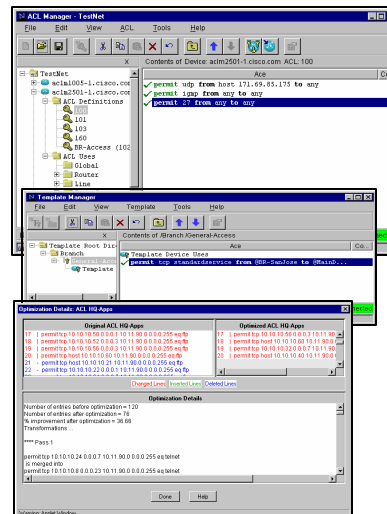
Leverages functions from Inventory, Configuration Archive, Transport, Change Audit, Schedule, etc.

- **Structured approach to managing ACL policies**

Reduces time to deploy multiple changes

Reduces errors in ACL definition

Reduces time and improved accuracy for add, moves and changes for users and servers



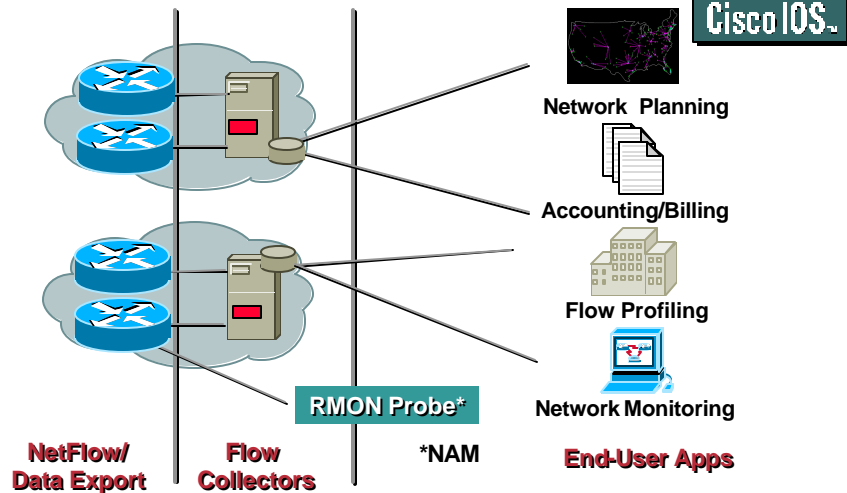
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# Accounting Management NetFlow

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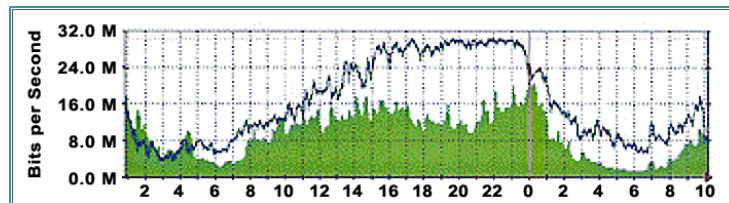
63

# Performance Management Real World Example

Cisco.com

## The Problem

- A university network administrator observes dramatic increase in **outgoing** WAN traffic resulting in increased costs and decreased response times



**Solid Green** Represents Incoming Traffic

**Blue Line** Represents Outgoing Traffic

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## Performance Management Real World Example

Cisco.com

### Considerations

- **What** traffic type is leaving the university?
- **Why** is the traffic being generated?
- **Who** is generating the traffic?
- **How** can this be prevented in the future?

### Management Processes in Place

- Link usage trending software
- **Traffic capture and analysis** capability
- Scalable **QoS policy** deployment software

**The Solution** →

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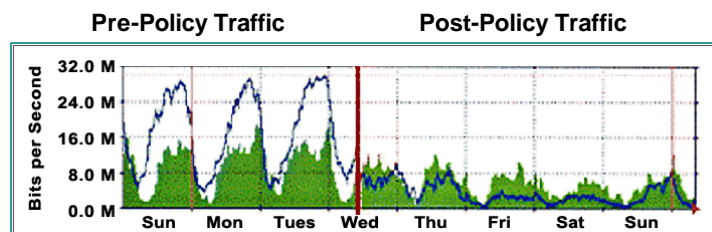
## Performance Management Real World Example

Cisco.com

### The Solution

The Network Congestion Was Being Caused by  
**File Sharing Applications**

The **Solution** Was to Deploy Quality of Service  
Policies to Edge Devices



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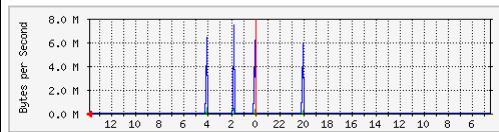
# Performance Management Link Usage Trending

Cisco.com

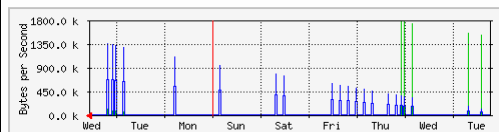
- University was logging incoming and outgoing usage over time with MRTG
- Monitors traffic load on network links based on SNMP statistics
- Generates real-time HTML traffic reports
- Can be used to monitor any SNMP variable you choose
- It's FREE! [www.mrtg.org](http://www.mrtg.org)

## MRTG MULTI ROUTER TRAFFIC GRAPHER

'Daily' Graph (5 Minute Average)



'Weekly' Graph (30 Minute Average)



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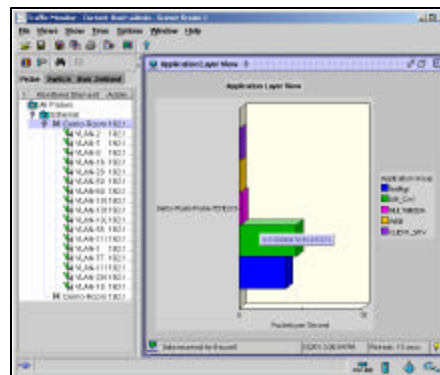
67

# Performance Management Traffic Analysis

Cisco.com



- Packet Capture and Decode
- Three-tier organization model example
- Collects RMON data from intermediate devices
- Tool analyzes data for performance metrics



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# Performance Management Traffic Analysis

Cisco.com

- **Network Analysis Module**  
Integrated Traffic Monitoring  
solution for Catalyst 6000 Family
- **Enables full Traffic Monitoring**  
Real time traffic analysis  
Performance monitoring  
Troubleshooting
- **Web based embedded Traffic Analyzer**  
VoIP, QoS(DSMON), ART,  
VLAN(SMON), RMON 1&2  
monitoring  
Data Capture and Decode, Alarms
- **Supported by other applications**  
nGenius Real-Time Monitor,  
CiscoView, Concord eHealth



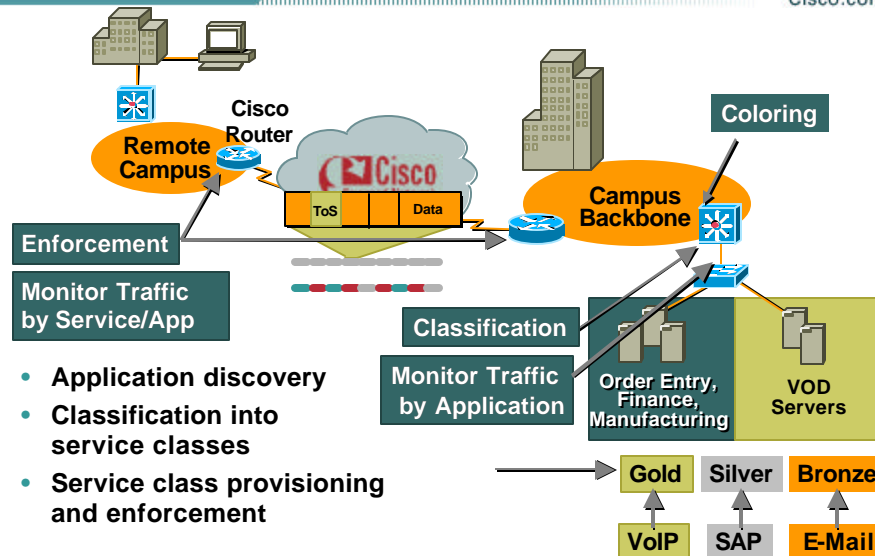
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# Performance Management Managing QoS

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- [illegible]

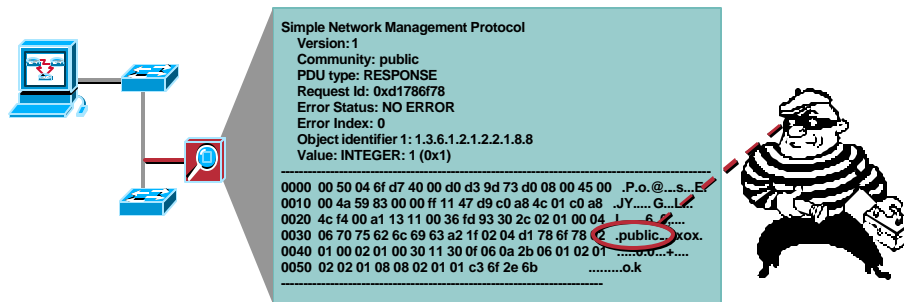
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- Network administrator was concerned that should the device SNMP community strings get into the wrong hands **sensitive information could be extracted and unauthorized changes made**



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## Security Management Real World Example

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### The Process

- Administrator must make choose from the following:

Make **frequent** and **time consuming** changes of the community strings on all devices

**Lock down SNMP access** to the managed devices

The Solution →

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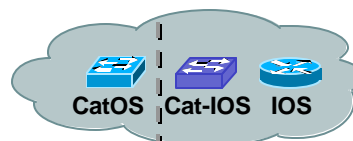
73

## Security Management Real World Example

Cisco.com

### The Solution

- The network administer deployed **access lists** to the vulnerable devices **to restrict SNMP from all hosts except those in a known secure subnet**



```
set ip permit enable snmp
Set ip permit 19.16.76.192 255.255.255.192 snmp
```

```
snmp-server community <MyString> ro 100
snmp-server community <MyString> rw 100
access-list 100 permit 19.16.76.192 0.0.0.63
```

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# Security Management Restricting Network Access

Cisco.com

- **User access to network services**

VPN access becoming more and more common

Common vulnerabilities are shared resources (i.e. computer labs)

- **Administrator access to network devices**

Third party authentication software

Username on network devices

Access control lists

Telnet, Console, and SNMP Access must be secure

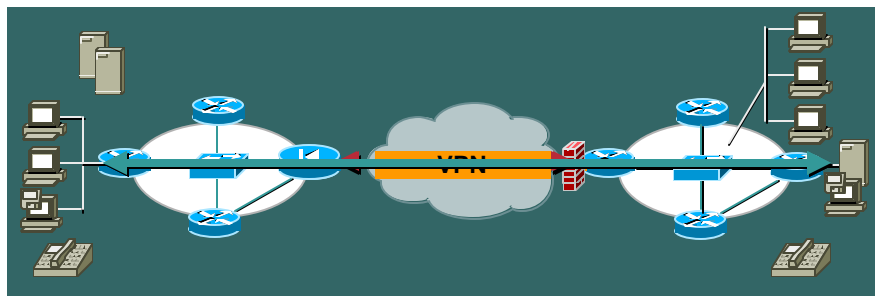
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# Security Management

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- Controls network access by configuring access points
- Protects the flow of sensitive information by provisioning IPSec VPNs to encrypt the data
- Protects from malicious network attacks using intrusion detection sensors

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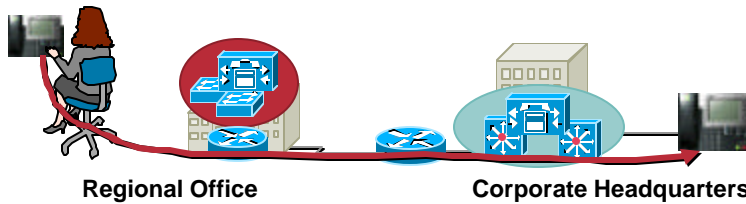
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# Voice Management Pulling It All Together

Cisco.com

## The Problem

- Branch office user complains of **inability to make a VoIP telephony call to corporate headquarters**



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## Fault Management

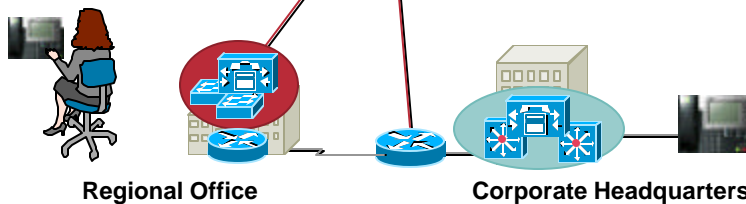
Cisco.com

- Do you have a fault detection and notification tool in place in the network? If so, you may already have the answer

The screenshot shows a web interface titled 'Voice Health Monitor Real-Time Dashboard - Summary View - Microsoft Internet Explorer'. It displays a table of system status information.

Voice Device Group	Number of Devices	Critical	Warning	Indeterminate
InlinePowerSwitches	2	2	0	0
VoiceGateways	6	3	0	0
VC-REMOTE-CALLMGR	1	0	0	0
VoiceServices	2	0	0	0
Voice-192.168.76.233	2	2	0	0

5 row(s)



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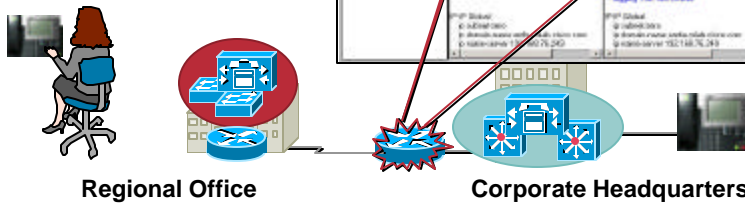
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# Configuration Management

Cisco.com

- Verify device configurations have not been changed to adversely affect VoIP



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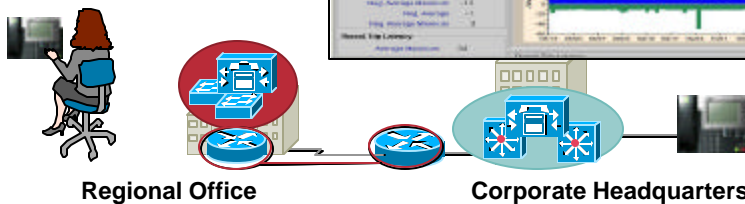
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# Performance Management

Cisco.com

- Compare current network performance against established baseline



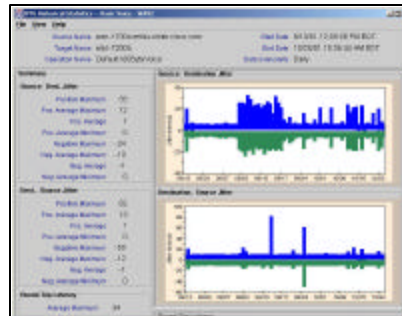
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- Your “source” and “target” must be an SA Agent capable router
- You must issue the global configuration to turn on the RTR (Response Time Reporter ) responder on the target

```
core-6506-msfc(config)#rtr responder
```

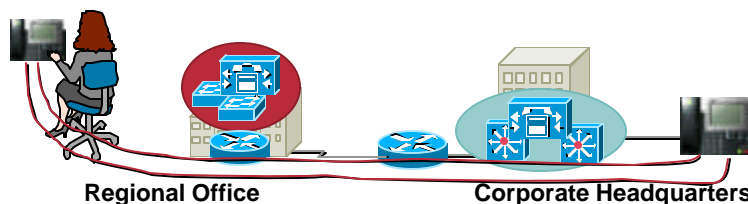
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- **When faced with a network problem regarding downtime or significant degradation, many different components of proper management must be in place to simplify the troubleshooting process**



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## Review of Agenda and Main Points

Cisco.com

### What Have We Learned Today?

- **The Need for Management**  
Contribution to Bottom Line through High Availability
- **Network Management Defined**  
Understanding and Controlling Network Information and Services
- **Protocols and Technologies**  
Communication Models, MIBs, SNMP gets, SNMP Sets, SNMP Traps
- **Functional Areas of Network Management**  
Fault, Configuration, Accounting, Performance, Security
- **Preparing a Network for Management**  
Configuring SNMP, Syslog, Telnet, CDP, ILMI, NTP, LoopBack
- **Real World Applications of Proper Management**  
Real World Examples

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## Conclusions

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- **Network management can best be defined in terms of the goals—Providing network users services with the quality and transparency they expect**
- **The network management model: Incorporation of all FCAPS components**
- **Network management tools to address each functional area**
- **Network management helps the bottom line—Efficiency and productivity**

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## Cisco Network Management Surveys – Continuous Improvement

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- **What:** Cisco network management product web surveys
- **How:** E-mail sent to product user list with URL link to a survey
- **Who:** Primary users of a Cisco network management product
- **When:** Surveys sent via e-mail after a product has shipped for 6 months. Typically we do two surveys on a specific product per month

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## Cisco Network Management Surveys – Getting Involved

Cisco.com

- Send an e-mail to Greg Ryan at Cisco: [gregryan@cisco.com](mailto:gregryan@cisco.com) if you wish to be on the survey list. He will ask you what Cisco network management products you have and which versions you are using.
- There is no obligation and you can opt not to take the surveys. A gift is mailed to all survey takers.

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## Further Study and References

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- **Network Management: A Practical Perspective—**  
**Leinwand and Fang Conroy ISBN# 0201609991**
- **Network Management: Principles and Practice—**  
**Subramanian ISBN# 0201357429**
- **How to Manage Your Network Using SNMP:**  
**The Networking Management Practicum—Rose and**  
**McCloghrie ISBN# 0131415174**
- **Performance and Fault Management—Della**  
**Maggiora, Elliott, Pavone, Phelps, and Thompson**  
**ISBN# 1578701805**
- **Cisco Enterprise Management Solutions—Wynston**  
**ISBN# 1587050064**

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## Other Network Management Sessions

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- **NMS-2021: Configuration of Large Scale Networks with**  
**CiscoWorks**
- **NMS-1031: Introduction to Collecting Traffic Accounting**  
**Information**
- **NMS-1011: Principles of Fault Management**
- **NMS-1051: Securely Managing your Network**
- **NMS-2001: Network Troubleshooting Tools and Techniques**
- **SEC-1000: Introduction to Network Security**
- **SEC-2006: Managing Security Technologies**

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## Recommended Reading

Cisco.com

### Performance and Fault Management

ISBN: 1578701805



Available on-site at the Cisco Company Store

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## Please Complete Your Evaluation Form

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